

Description

Acoustical Absorbing Architectural Coating and Process

BACKGROUND OF INVENTION

[0001] Many Coating manufacturers are currently claiming acoustical reduction in coatings due to the inclusion of ceramic particles in architectural paint. These claims are largely inaccurate and misleading. Paints form a continuous polymer film over a surface. This continuous polymer film reflects sound. The inclusion of sound absorbing materials in such a coating is irrelevant as the sound absorbing material is not directly impacted by the acoustical waves, rather the encompassing coating reflects the incoming waves before any acoustical damping takes place. In fact NONE of these manufacturers have an acoustical rating as defined by a noise reduction coefficient associated with their products which is greater than that offered by a standard paint. The current invention differs from the prior art in the use of a lattice work structure rather than a

continuous film. The lattice work structure is applied as a coating and may be of a variety of densities or porosity, but the exposure of attenuation material to the incident sound is critical.

[0002] The field of the invention is the process of damping or attenuating sound incident upon an architectural surface. The control and engineering of sound levels has been regarded as an independent discipline for at least 100 years. In Residential environments, the quality of life has been directly tied to the ambient noise levels (consider for instance studies done regarding airline flight paths) In industrial environments there are critical concerns regarding productivity of employees and incident stress on equipment which is related to the ambient noise level. This invention is directed at the process of economically reducing noise levels in these environments. ART A sound source produces pressure variations in the air moving outward from the source in a progressive wave at a speed of about 1100 feet per second. In free space, the energy intensity in the wave decreases as the distance from the source increases. Sound waves indoors are reflected many times by the enclosing surfaces, the intensity remaining more or less uniform throughout a room. The sound wave

carries energy from the source to the ear or other receiver. The present invention is specifically directed towards usefully reducing the intensity of these sound waves. The amount of sound energy that reaches the listener depends on the paths by which the sound has traveled, on the distance from the source, the power of the source, and the nature of such intervening barriers as walls, doors, windows, and sound-absorbing ducts. Qualities that characterize a desirable acoustic environment vary widely, depending on how the space is to be used, how particular the users are, and how the specific space involved relates to other parts of the building. When a sound wave strikes a sizable surface, such as a wall or ceiling, part of it is reflected, part of it is absorbed, and part of it may be transmitted to some adjoining space. The relative magnitudes of the three parts of the original sound are determined by the physical properties of the surface. A hard-surfaced, painted sheet of drywall reflects most of the sound that strikes it, while a soft surface such as a heavy carpet reflects little sound. Absorption and reflection are important only in connection with the space in which the sound originates. Useful sound absorption is provided by porous material such as carpets, draperies,

glass-fiber blankets, clothing, and specially-made sound-absorbing materials. An essential property of a sound-absorbing material is that it have a porous structure into which the molecules in the air carrying sound energy can dissipate that energy in the form of heat. This porous structure CANNOT be supplied by a traditional paint where the resin binder of the coating develops a continuous film. Sound energy so dissipated is never recovered as sound. When sound-absorbing materials are placed within a room, the reflection of energy is greatly reduced and the sound dies away rapidly. Good hearing conditions for an audience listening to speech or music, whether in an auditorium, courtroom, church, theater, or living room, depend on four basic conditions. The space must be quiet, the sounds to be heard must have adequate loudness, there must be a good dispersion of sound, and the sounds must be properly blended, with adequate separation for good articulation of music or speech. The velocity for a sound wave is directly proportional to frequency and the medium of transport. It follows that any substance that absorbs sound will tend to absorb high frequencies more than low frequencies. However, the principle of resonance in physics can be used to increase the velocity in a

sound wave at or near a resonant frequency and thus to increase absorption at low frequencies by design of suitable resonators. The present invention addresses the difficulties typically found in absorption media by providing absorbers for lower frequency sound waves.

[0003] It is an object of the present invention to absorb both high and low frequency sound in industrial and residential architectural environments. is further an object of the present invention to provide an economical method to reducing unwanted noise in existing structures. It is a further object of the present invention to reduce the structural stresses associated with extreme acoustical vibration in hot gas environments. It is a further object of the present invention to enable a process of absorbing sound where the set up of the mechanism through which the process of absorbing the sound is effected involves nothing more than the application of a coating. These and other objects and advantages of the present invention will become apparent from a reading of the attached specification and appended Claims.

DETAILED DESCRIPTION

[0004] **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[0005] The present invention details a article of manufacture and a process of acoustical absorption which utilizes that article. The article to be described below as the preferred embodiment uses a carrier system which generally involves a binder which may be a water borne polymer system or a solvent borne polymer system, additionally the binder may be an inorganic adhesive, or an inorganic salt. The preferred embodiment uses a water borne single component vinyl acrylic. It should be understood that the vinyl acrylic could be any one of the multitude of acrylic"s, polyurethane"s, epoxies, polyurea"s, etc which are typically used for coating applications. The binder system in the preferred embodiment requires a coalescing solvent. Each binder system has a variety of coalescing solvents which work with varying degree"s of effectiveness and which impart a number of application oriented properties such as dry time, viscosity etc. One skilled in the art would generally know the specific coalescing solvent for each binder system. For the preferred embodiment texanol coalescing solvent is used at a ratio recommended by the manufacturer of the resin. The preferred embodiment uses a binder to volume ratio such that the final composition forms a substantially continuous lattice, network or

porous structure. This structure or framework having vacant and non vacant cavities. preferred embodiment chemically or mechanically retains a plurality of mechanisms for altering, attenuating, reflecting, or absorbing sound. The mechanisms that alter, attenuate, reflect or absorb sound in some cases may be mechanically attached in the network structure, and in other cases may be chemically bound to the aforementioned lattice work. The preferred embodiment contains projection surfaces which act as mechanisms for projecting acoustical waves towards the absorbing or attenuating means. In the preferred embodiment the projection surfaces are composed of either one or a plurality of plate like ceramic particles selected from the group of platelet clays, platelet talc, mica, or plate like zirconium carbide. It is presumed that a number of materials may be available which due to plate like geometry are able to perform this function. These plate like materials serve a dual function, some of the plate like material will be exposed as a reflection surface, for example with the thin dimension of the plate perpendicular to the incident sound, in this case the plate like structures will reflect the sound. A portion of the incident sound will be immediately redirected, and some will be

absorbed immediately. The means for absorbing the sound may operate as the sound is first incident or it may operate after the sound has been redirected by the plate like structures which are operating as reflectors. Some of the plate like material will have an exposed (of small relative dimension) edge. This exposed edge allows the same plate like material to act as a stub tuner would in traditional vibration damping applications, where such stub tuners are extended into vacant areas defined within said lattice structure; said stub tuners being non uniform in extended length. In the preferred embodiment the stub tuner mechanisms are composed of ceramic particles having a high aspect ratio in either one of three or two of three dimensions such as rods or plates, a plurality of these same exposed edges arranged together function as a baffle for the incoming acoustics. In the preferred embodiment these absorption particles may be composed of either one or a plurality of plate like ceramic particles selected from the group of platelet or rod like clays, platelet talc, mica, or plate like zirconium carbide. Additionally there are absorber means comprised of ceramic microspheres. Ceramic microspheres are generally known in the art and independent of a coating these microspheres are

known to provide acoustical damping. In many recently developed coatings these microspheres are simply added to a traditional paint and the paint is then claimed to have sound absorbing properties. In fact as the microspheres are then covered by a sound reflecting material the bulk of their sound absorption properties are not retained in the coating. the preferred embodiment fibrous reinforcement is also utilized. The fibrous reinforcement may add a great deal of functionality to the coating. In the preferred embodiment these fibrous reinforcements add a method of crack propagation resistance. The novelty of the current invention is not only resident in the article of manufacture, but additionally the manner in which sound is attenuated. Sound is damped by economically applying multiple layers of a coating which uses means for transmitting sound incident upon a surface. In the preferred embodiment this means for transmitting sound is a loosely bound ceramic particles forming a non continuous highly porous layer. Within the first layer and within the second layer are means for absorbing sound and means for redirecting sound by means of plate or rod like structures once that sound has been transmitted. These plate like structures substantially perform a baffling function and they act as

sympathetic resonators. The plate like structures in the preferred embodiment are comprised of various forms of plate like kaolin and talc, however it should be understood that most plate like ceramic particles could be incorporated to serve this function. Also absorbing sound in the first absorbing portion is effected by the use of hollow ceramic particles as resonant cavities. There are a wide variety of these particles which are known in the art and provided they are fit the definition of hollow ceramic spheres, they will appropriately aid the process of sound absorption. The sound having been partially absorbed by the initial surface and partially directed into the cavities of a coatings first absorbing portion may then run into a second absorbing portion where said incoming sound is further transmitted against an applied substrate. The substrate will act as a sound reflecting surface as it is situated directly after the second absorbing portion. This second absorbing portion may be substantially comprised of closed cell cavities in which incoming sound is damped by its own reflection and a plurality of sound attenuation media for absorbing acoustical energy. Further this second absorbing portion is comprised of a porous structure with adhesive bonding capability substantially integral with the

lattice work previously mentioned. This adhesive bonding mechanism causes attachment of said second absorbing layer to a surface of interest. The surface of interest may be acoustically reflective or it may provide additionally sound attenuation properties. Within the scope of the preferred embodiment it may be desirable to apply either a single layer or a plurality of substantially equivalent layers. The fibrous reinforcement in the preferred embodiment may be used to add additional sound attenuation properties, or they may be used to enhance thermal or electrical conduction. Additionally the preferred process used may further utilize a lattice work which enables the damping of sound in a hot gas environment. Reinforcing the lattice structure with a thermal conduction mechanism may further assist this hot gas capability. It may also be desirable to utilize this coating as a smart coating surface where electrical conduction for either the dissipation of static electric charge, or the conduction of electrical currents for sensing applications or low power transfer. To effect this a number of ceramic materials which also may act as acoustical reflectors or as acoustical absorbers as generally known in the art may be used such as Indium tin oxide or Antimony tin oxide may be used. A particularly

interesting embodiment involves the use of a piezoelectric material such as barium titanate to convert the acoustical energy incident on the coating into electrical energy to be dissipated or transmitted by the coating. Alternately the process described in the preferred embodiment may be extended where the process additionally involves the resistance of mildew growth through the retention of sufficient porosity to enable a permeability rating or flame spread equivalent to a class 1 fire rating.

[0006]